A Management and Economic Survey in Implementation of Blown Bitumen Production Using Acidic Sludge Recycling (A Case Study)

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ABSTRACT

Many units of blown bitumen and used-motor oil reprocessing industries have been currently implemented and many modern technologies and additives are being developed and requested continuously. The objective of current study was a management and economic survey in implementation of blown bitumen production using acidic sludge recycling as a new additive that encompasses financial views and other success factors so carried out using a Kanji's Business Excellence Model, empirical equations, professional experiences and observations during establishment an industry. Using acidic sludge had promoted the product quality in parallel with the TQM parameters. Current study had shown the indices values such as value-added percent, profit, annual income, breakeven point, value-added, output value, data value, variable cost of commodity unit and production costs were found to be about 44%, $ 5308605.14, $ 5252251.65, $ 1183.67 , $ 5401935.47, $ 6748064.5, $ 12150000, $ 140.93 and $ 6897748.4 respectively. The breakeven point about 2.46%, time of return on investment about 0.07, BES about 800.2 (for KBEM) and 806.77 (for EFQM) was represented a systematic practice so that thrift outlays and boost the strength and weakness points to improve.

Keyword: Management and Economic, Blown Bitumen, Recycling, Acidic Sludge

Nomenclature	
TQM	Total quality management
KBEM	Kanji's business excellence model
EFQM	European federation for quality management
BES	Business excellence score
OE	Organizational excellence
USA	United State America
UK	United kingdom
CSF_S	Critical success factors
BE	Business excellence
MBNQA	Malcolm Baldrige National Quality Award
UNEP	United Nations Environmental Program
PI	Penetration index
PG	Performance grade
SHRP	Strategic highway research program
BES	Business excellence score
Wt%	Weight percent
LL	Liquid limit
PL	Plasticity limit
PI	Plasticity Index

INTRODUCTION

The first time, the Peters and Waterman were offered the concept of excellence in relation to management and organizational performance. Globalization and competition lead to the presentation of quality awards for companies and development more [1]. Integrated management will encompass all required activities and expectations of the customer and the community. Therefore, aims of the companies are complacence in the best condition for all employees in a continuing state to improvement [2, 3]. All organizations are evaluated for the development, furtherance and sustainability in today's competitive performance assessment systems [4, 5]. Performance assessment concentrates on the reasons that explain thrive or defeat in terms of historical perspective. OE is estimated by the complacent of customers, employers and shareholders [6]. In the real world, a company needs to survive by adapt with changes in its external environment. So, the main objective of implement the business excellence models was integrating the different parameters to adapt themselves to their environment. A key factor in these models is the proceeding the company's outputs in a systematic condition to reinforce performance [7].

Using EFQM for organizational self-assessment gets back in 1992 in Europe then its applied by 14 European large companies as a model to evaluate the European quality award in 1998 [8]. After studies at higher education institutions in Northern Ireland, it was concluded that the EFQM in many aspects for different aims is applied in an organization. Owners from 40 European companies such as Renault, Fiat, Philips, British Telecom, and others were based on the EFQM [9]. These models have actually been utilized in various countries such as USA, UK, Malaysia and Japan. European universities have used EFQM as a practice to a survey of their performance [11, 10]. Tambi *et al.* (2008) have offered the use of KBEM as a tool for quality review and enhancement of higher education institutions [12]. Hassanpour *et al.* have reported the stream of sustainable development using KBEM in used motor oil industries [13].

Based on a database of Iranian industry organization, there are more than two hundred recycling units of used motor oil currently. The recovery practice for used-motor oil in Iran companies is the acid / clay process. Acidic sludge is a by-product of this process. Unfortunately, in this process, from one hundred barrels of used-motor oil, just fifteen barrels of acidic sludge are obtained as refuse. There are many practices so that disposal of acidic sludge such as incineration, landfill, refuse and recovery. Acidic sludge composition is very complex and it is not yet known well. The acidic sludge encompasses unsaturated compounds, which are polar and asphaltene. Acidic sludge composition approximately is similar to bitumen. Bitumen contains hydrocarbons with high molecular weight including oil, resin and asphaltene [14]. Many studies showed that acidic sludge, as a by-product (industrial waste), could be converted to the valuable products and raw materials of other processes, such as manufacturing processes, including organic fertilization, explosive materials, paint, ink, chemical fiber and industrial detergent [15]. Based on the studies of technical and economical view-point that have been conducted by the Iranian industries organization, the bituminous materials are used as a raw material or the additives for cycle of production in different industries such as wool fibers, booklet, laminated paper envelopes, asphalt heat insulation, plastic bags, automotive fan belt, PVC flooring, proof insulated pipe covers, blown bitumen, emulsion bitumen, polymer bitumen, complementary of bitumen refinery, motorcycle battery, paint, ink, printing ink, liquid bitumen and etc [16].

Regard to the number of existing industries in developing countries and world, quality of products obtained and the quantity of utilization, it is necessary that focus on the performance of these industries and sustainable development aspects during establishment and operation. Krajnc *et al.* has explained many descriptions of sustainability which encompass the environmental performance, societal responsibility and economic assessments. Economic estimates of indices concern the impacts of the industry on the economic identity of its stakeholders on layout feasibility to implement [17]. Fagerberg reported that industries have an important and significant role to achieve stable and rapid economic growth and development [18]. Development study of an industry describes the different elements of the financial, performance and economic aspects of industry and estimates closely the running costs. The major costs can be devoted into organization and control costs incurred by the central office, sum of costs and operational costs of the final storage facility prior to recycling costs. Cost computations are based on estimates that reflect typical investment costs, interest rates, transportation costs, materials, equipments and fixed, working costs and etc [19]. In present research was used of performance assessment and economic indices such as value-added percent, profit, annual income, breakeven point, time of return on investment, value-added, output value [20]. Marchetti *et al.* have studied the economic indices such as evaluate productivity, raw material consumption, economic competitiveness and environmental impacts of each process [21]. Bradley *et al.* have studied on the relationship between oil price and some key macro-economic variables. Also, investigation on the crude oil price with output, prices of consumer, unemployment, and stock [22]. The main objective of the present study was management and economic survey in implementation of blown bitumen production using acidic sludge recycling during establishment an industry.

MATERIALS AND METHODS

1. Performance assessment

KBEM body is relies on CSFS. CSFs encompass the required activities to reach the organizational objectives. Therefore, CSFS are associated to key motors of performance. BES is the final outcome of overall OE in uniting all CSFS. The role of KBEM and Kanji business score infer to the assessment of organizational performance on the internal and external stakeholders respectively. Thus, it was used from equation 3 so. KBEMS is equal with performance excellence A plus B.

$$BES = \frac{A+B}{2} \times 10 \quad (1)$$

$$KBEM = A + B \quad (2)$$

$$B = \frac{\sum BI}{N} \quad (3)$$

In order to study different factors together were used multiple weighting systems. Each of KBEM items has a worth equal with 50 scores in EFQM. Therefore, in the aforementioned system were added 900 scores for items in EFQM until KBEM be enabled to survey OE values in a diagram. Each of factors of the EFQM must be jointed with more than one dimension of KBEM. In the present study each item of the EFQM must be matched with two items of KBEM [23, 24].

2. Description of economic estimation practice and equations

In the current study was assumed a working shift of 8 h/day, for 270 working days per year. The required electrical energy and water were computed on 300 working days per year. The required water was calculated 100 L/person – day. Total daily required water for the fire fighting was estimated by a factor of 1.5. The salaries of the staff were computed for 14 months including 23% of total salaries for insurance costs and pensions with $ 100 transportation costs per month, for each individual. In present research was avoided from getting a loan. The equipments cost which contributes to the capital costs was calculated from the data of the market of Tehran, professional experiences, collected data and observations in spite of industry in West Azarbaijan, Iran. In the current study all requirements have been supplied from Iran and there was not any import. Finally, economic evaluation was fulfilled with empirical equations 4 to 14 and professional experiences [25, 26].

$$Q = MC'T \quad (4)$$

$$W = 0.75(\sum e) \times A \quad (5)$$

$$C = 0.005 \times P \quad (6)$$

$$V = p - ((\sum)e + A' + F + Cf) \quad (7)$$

$$\%V = V \times 100 / p \quad (8)$$

$$Qp = V - ((\sum)I + L + D + S) \quad (9)$$

$$Cv = Cvd / Cp \quad (10)$$

$$Ph = Tf / Cv - Cs \quad (11)$$

$$Cpi = Cvp + Cfp \quad (12)$$

$$Ai = Ts - Cpi \quad (13)$$

$$Vt = If / Ai \quad (14)$$

In equations 6 to 16, Q, M, C, T, W, e, A, C, P, V, A, F, Cf, Qp, I, L, D, S, Cv, Cvd, Cp, Ph, Tf, Cs, Cpi, Cvp, Cfp, Ai, Ts, Vt and If, are the required heating rate (KJ), flow rate (m3/h), thermal capacity, temperature (K.), required electrical energy, sum of electrical energy consumption (facilities, manufacturing line apparatus, building and campus), area (m^2), selling costs, selling price, value-added, initial materials (Additives, materials, packages), maintenance, unforeseen costs, profit, insurance, cost of interest and fees, depreciation, salary, variable costs of good unit, variable project costs, production capacity, breakeven point, total fixed costs, selling cost of commodity unit, manufacturing costs, variable manufacturing costs, fixed manufacturing costs, annual income, total selling price, time of return on investment and fixed capital respectively [27,28].

3. Description of procedure for the landscaping, pavement and asphalt tests

Aggregate and asphalt samples were collected and then evaluation tests performed on samples. This part of the study was performed in the technical and soil mechanic laboratories and in location of implementation of project via collecting the aggregates, hot asphalt and Marshall samples from several locations at the industry. Tests of aggregates included coarse and fine aggregate angularity, sand equivalent (AASHTO T176), coarse and fine aggregate and Los Angeles test (AASHTO 96-51, ASTM C131, D5760). Current study encompassed the tests from, Resistance and Softness (ASTM D-1559), Breakage (ASTM D-244 for asphalt, D-5812 and D-5821 for aggregates), Specific Gravity (ASTM D2389 – 78, AASHTO T160, ASTM D1119 and AASHTO 84 to moisture of fine aggregate), Density (ASTM D-70), Aggregate Grading (ASTM D422, AASHTO 27-60), LL (AASHTO T289, ASTM D423), PL (AASHTO T90, ASTM D424), PI (PL-LL), Empty space of asphalt (ASTM D2041), Compaction (ASTM D1557), Thickness of asphalt (ASTM D5199), Thickness of base layer (ASTM D5199). In order to determine values of tests the space filled with bitumen, bitumen/mixed asphalt, bitumen / asphalt without bitumen, empty space (asphalt and aggregates) and empty space of aggregate filled of bitumen was used (AASHTO T305) [28].

RESULTS AND DISCUSSION

1. Performance assessment of blown bitumen production industry

There are many models to survey the BE such as MBNQA, TQM, KBEM and EFQM. EFQM as a non-prescriptive of TQM body encompasses nine parameters such as leadership, policy and strategy, employees, resources and partnership, process, customer results, employees results, community results and key performance results in contrast with that KBEM includes leadership, satisfy of customers, satisfy of the external customers, satisfy of the internal customers, fact-based management, process, measurement, management relies on employees, team work, employees make quality, continuous improvement, continuous improvement cycle and prevention [29]. The concepts used in this model with the key ingredients of TQM are analogous. There are important overlaps among many models of being in terms of factors. Various factors of EFQM are analogous with KBEM. The framework of both EFQM and KBEM has been based on scientific approaches based on identification and validation of the CSFS. These approaches are not relied on the discipline empirical evidence. KBEM can set up as an accurate methodology so that estimate interactions among key motivations of performance. Many of these models have the quality or quantity contents. In quality view is used from equations. The objective of evaluation these models is present a perspective from strength and weakness points and areas to be improved in companies and industries [30]. Table 1 represents the network of comparison scores.

Table 1: Network of comparison scores

EFQM	KBEM	Score
Leadership	Leadership (60%)	60
	Satisfy of customers (10%)	10
	Fact-based management (10%)	10
	Management relies on employees (10%)	10
	Continuous improvement (10%)	10
		100
Policy and strategy	Leadership (30%)	30
	Fact-based management (20%)	20
	Satisfy of customers (20%)	20
	Management relies on employees (20%)	20
	Continuous improvement (10%)	10
		100
Employees	Management relies on employees (40%)	40
	Employees create quality (50%)	50
	Continuous improvement (10%)	10
		100
Resources and partnership	Team work (50%)	50
	Measurement (50%)	50
		100
Process	Process or total work (50%)	50
	Fact-based management (40%)	40
	Continuous improvement (10%)	10
		100
Customer results	Satisfy of customers (50%)	50
	Satisfy the external customers (25%)	25
	Satisfy the internal customers (25%)	25
		100
Employees results	Prevention (50%)	50
	Management relies on employees (30%)	30
	Continuous improvement cycle (20%)	20
		100
Community results	Satisfy the external customers (25%)	25
	Satisfy the internal customers (25%)	25
	Satisfy of customers (20%)	20
	Leadership (10%)	10
	Continuous improvement (20%)	20
		100
Key performance results	Fact-based management (30%)	30
	Continuous improvement (40%)	40
	Continuous improvement cycle (30%)	30
		100

The industry's main activity (process criteria) was production of blown bitumen for roads, pavement, asphalt, landscaping projects and etc. Results of Table 2 shows that blown bitumen production projects can create an opportunity for BE and satisfaction, among internal and external clients. Blown bitumen production projects are fulfilled using a team [31]. The quality of projects completed thoroughly is depending on the management and supervision of the executives of the team and internal organization. Therefore, the process of continuous improvement, used strategy and policy, satisfy of the citizen and customers, satisfy of the internal and external customers correctly was quite apparent within the body of industry. Also, it will prosecute complacent of community as reduced wastes and energy. Resource and partnership criteria encompass the management of several factors such as external partnerships, financial factor, buildings, equipment and materials, technology, information and knowledge [31, 32].

Table 2: Comparison of scores system in a blown bitumen production industry

KBEM		EFQM	
Criteria	**Score**	**Criteria**	**Scores**
Leadership	90.33	Leadership	90.55
Satisfy the citizen and customers	77.5	Policy and strategy	87.7
Satisfy the external customers	60	Employees	85.83
Satisfy the internal customers	60	Resources and partnership	90
Fact-based management	74.16	Process	81.66
Process or total work	82	Customer results	78.33
Measurement	60	Employees results	73.88
Management relies on employees	70.41	Community results	70
Team work	98	Key performance results	49.42
Employees make quality	73		
Continuous improvement	71.4		
Continuous improvement cycle	74.8		
Prevention	80.5		
BES	800.2	BES	806.77

Hassanpour represented using this model based on the criteria and results obtained the used motor oil industry was in sustainable development conditions. Jonidi *et al.* noticed that the both parameters of customer and community results were the strength points while the resources and partnership the weakness points in performance assessment of three companies (Road Construction) [33]. Amiri reported both parameters of focus on customer and social results were strength points but process management, resources and the weakness points in a hospital [34]. Arjomandi *et al.* using EFQM showed that implementation of policies and practices will guarantee the quality in all aspects of its furtherance in universities [35]. Tambi has suggested the use of KBEM to describe the values of indices promoted and corresponding performance indicators as a practice to elevate quality and survey of higher education departments [36]. Dahlgaard to explain excellence by concentrating on some of the CSFS showed that the results will pursue great privileges both for researchers and practitioners as well as industries [37]. Baidoun presented the analogous results of TQM about 100 percent in 78 organizations, 78 targets, with 78 valuable questionnaires, 19 factors from through three tiers in Palestinian [38]. Gopal *et al.* reported appropriated adaption for the cope with chain performances of 139 companies in relationships between supply chain management and TQM on afford chain activities in Hong Kong [39]. Tutuncu *et al.* showed relationship significant between EFQM and organizational commitment of Meyer & Allen Organizational Commitment scale. Leadership, partnerships and resources, policy and strategy, affective commitment, processes, results, people development and involvement and continuance commitment were the determinants of the organizational commitment and EFQM respectively [40]. Hendrics was achieved to relationship significant in the post establishment period (5 years after the award) on 600 awards winning companies with companies chosen from the same industry in North America. College companies achieved 8% mean rise in 1 year after the award in sales revenues to 17%, 3 years after the award and 77%, 5 years after the award. Also, there was a significant promotion of 18% in operating income, 40% in total capital and a 4.4% fall in expenses over sales 5 years after the award [41]. Ritchie D. showed that potential to analyze organizational performance and points to boost and fortify the commercial aspects was underestimated by leaders and the quality award process was clarifying their effects in 10 companies on the self-assessment practices. [42]. Xu *et al.* showed handling different types of ambiguous and incomplete data and wide interval of information such as scores, performance diversity, strength and weakness diagrams [43].

2. Blown bitumen production practices

This procedure is also done in two practices such as catalytic and non-catalytic. In catalytic practice is added some chemicals additives during the process to reduce the aeration period. Some advantages of this procedure can be mentioned to simplicity of aeration conditions and generation, various grades, being easy implementation of the unit and low investment (batch production). Blowing air operation must be done via bottom of the aeration tank, the reaction between bitumen and air is exothermic. Some precautions are urgent to control temperature. Therefore, the reaction temperature is controlled by water injection. Incorporation of feed air and bulk of air blown to bitumen in aeration process are two prominent variables. The result from this process usually is bitumen 60/70. In this case, to produce bitumen 90/15 or 85/25 is injected 20 – 25% volume ratio of oil distilled or crude oil to the feed bitumen in order to promote and elevate the flexibility of product. Due to a rise in temperature, the amount of air injected, detention time and pressure of the tower, the reaction speed increases. In order to achieve to the appropriate product and impede against advent explosive conditions must be actually controlled the temperature at the 265-270$^{\circ C}$. After cooking bitumen in tower should be immediately discharged to an empty tank or barrels to be delivered. The long retention time of the bitumen is dangerous to the devices. Aerated tower contains 70% bitumen and the air injection operation is done at 232 to 190 $^{\circ C}$. In the end, the temperature for the product should be kept between 150 - 165$^{\circ C}$ so that loading and packaging. On the other words, the blown bitumen production operation mainly encompasses various stages of loading tanks, bitumen aeration, cooling and packaging. It should be noted that the gases and vapors produced during operation through the aeration pipes installed in top of the tower are entered into contact condenser. In this section, by spraying water, the smelly gasses, oily and non-volatile components from the gas phase separated and transferred with water into the sewage. Other non-separated components are escaped from the condenser and then transported into the furnace, and burned [44]. Fig.1. represents layout units of the blown bitumen production industry.

According to the report of Iranian industry organization, more than two hundred reprocessing units (acid / clay process) of used-motor oil are currently running in Iran. The acid / clay process has minimal environmental safety. The main by-product of this process is the huge amounts of acidic sludge. Acidic sludge is a by-product from acid/clay process which is classified as hazardous waste material.

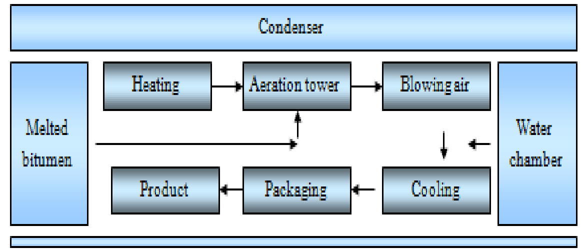

Fig.1. Layout units of the blown bitumen production industry

Acidic sludge basically encompasses unsaturated compounds, which are polar and asphaltene. Acidic sludge composition is analogous to bitumen. Bitumen encompasses hydrocarbons with high molecular weight such as oil, resin and asphaltene. Hassanpour *et al.* reported that the environmental and health hazards of acidic sludge can be decreased by its modification and neutralization. Also, for it to be used as the primary raw material in the production of bitumen, acidic sludge has to be modified or amended in one way or the other. Table 3 represents the performance parameters of acidic sludge and concentrated acidic sludge. The observations and findings of Jonidi *et al.* have been summarized in Table 4, for the production of bitumen 54/130 from acidic sludge. The obtained products could also be utilized in building and road construction according to its specific bitumen criteria and characteristics [44]. Fig. 2 represents a diagrammatic layout of acidic sludge recycling units and reprocessing industry of used-motor oil.

Blown bitumen 90/15 is the product of blown bitumen production industry by using raw oil to generate. Bitumen 60/70 is a raw material for producing the 90/15 bitumen with the physical properties such as penetration degree 58 dmm, Softening point 50^{oC}, Frass breaking point -12^{oC}, PG 70-22, Saturates 15.66 wt%, Naphthene aromatics 39.15 wt%, Polar aromatics 35.04 wt% and asphaltenes 10.15 wt% [45]. Using the acidic sludge as a new additive (as an initial, concentrated or recovered product to 54/130 bitumen) to generate the blown bitumen has been promoted the softening point from 90 to 110. TQM encompasses many aspects related to products such as customer focus, information and the analysis, training, supplier management, strategic planning, employee involvement, product and service design, process control, continuous improvement, quality assurance, social responsibility and employee satisfaction. Generally, all TQM concepts have been properly considered in the production chain of the industry.

2.1. Description of economic estimation

The requirements of blown bitumen production industry as a case study were estimated according to Table 5. Other requirements were estimated using empirical equations 4 to 14, professional experiences and based on collected data in spite of industry and observations [46].

Table 3: Performance parameters of acidic sludge and of concentrated acidic sludge (Jonidi *et al.*, 2014)

Properties	Reference	Values of acidic sludge	Values of concentrated acidic sludge
Softening Point (^{o}C)	ASTM-D36	25	37
Weight loss %	ASTM-D6	3	1.38
Penetration degree (dmm)	ASTM-D5	*	230
PI	Empirical equation	*	-0.07854
Frass Breaking Point (^{o}C)	IP ASTM 2000; Part 80; EN 1259	*	-5
PG	SHRP system	*	(-16,58)
Temperature Sensitivity	Empirical equation	*	0.0451

*These parameters were not measurable

Table 4: Performance parameters of acidic sludge recycling (ASTM, 2000)

The properties of bitumen	The optimal properties of bitumen for climatic conditions of Iran	Jonidi *et al.* (2014)
Softening Point (^{o}C)	20 to 85	54
Weight loss %	1	1
Penetration degree (dmm)	30 to130	130
PI	-2 to +2	0.5774
Frass breaking point	-12	-11
PG	Different	Different

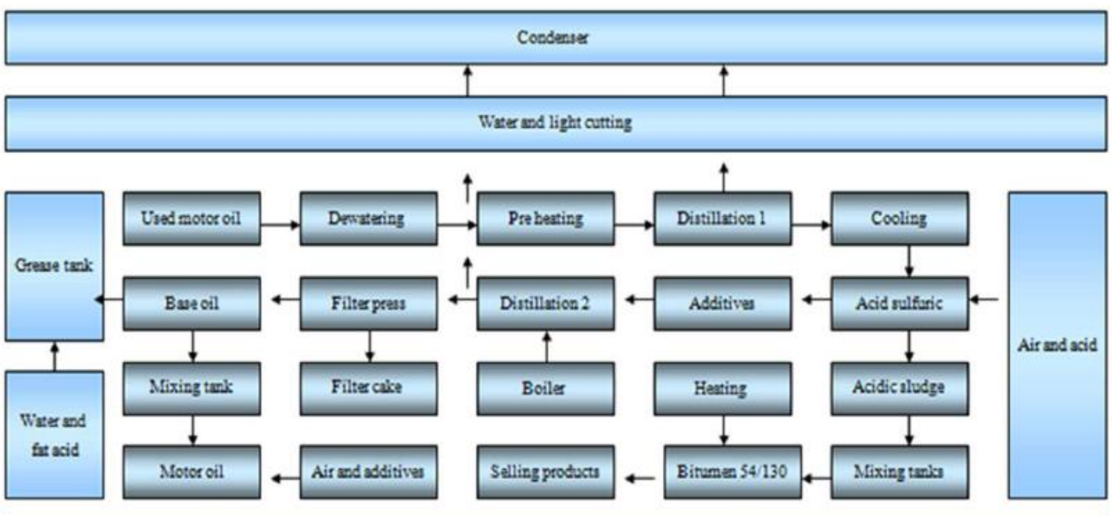

Fig.2. Diagram of layout acidic sludge recycling units and reprocessing industry of used oil (Jonidi *et al.,* 2014)

According to Table 5 the cost of energy consumption includes the water, fuel, petroleum and electrical costs. The costs of additives, packages and required materials include the bitumen 60/70, raw oil or acidic sludge, Boxes 35 kg and Barrels. Total costs related to the water supply facilities, split AC (Internal wiring, transformers and emergency power generators), fire extinguishers (Total), stoves (Total), coolers (Total), ventilation system (Total), office equipments, furniture and etc and Lab equipments (for quality control) are called the investment in facilities. Cost before of the operation includes the costs related to initial studies, training, pilot plant, running, operating period and etc. There is a list from costs that are called fixed and working capitals (Table 6). The investment amounts to embed an industry unit are estimated by fixed and working capitals. In an industry are calculated costs for depreciation, maintenance, operational and non-operational. Tables 7 and 8 represent the depreciation costs, maintenance, operational, non-operational fixed annual capital and total fixed and variable manufacturing costs respectively.

Total costs of manufacturing are equaled with sum from fixed and variable manufacturing costs. Table 9 shows the total manufacturing price. 2% summation from costs associated to additives, packages and required materials, staff salary, energy consumption, maintenance, depreciation of fixed capital, insurance, interest and fees are called unforeseen costs and sum from all prices are the total manufacturing costs in this table.

Table 5: Requirements blown bitumen production industry

Main annual material and equipments	Total annual rates	Total cost $
Bitumen conveyor pump (17 Atmosphere)	2 Number	20000 [a]
Compressor or centrifuge (Capacity 22 m^3/min)	2 Number	15150 [a]
Aeration tower (45 tons, CS, thickness 5 mm)	1 Number	33000 [a]
Kiln (2*2*3 meters)	1 Number	3030 [a]
Flame (3 hp)	7 Number	900 [a]
Storage tank (70 tons)	4 Number	28000 [a]
Condenser with capacity 85 m^3/min (V=3 m^3)	1 Number	210[a]
Bitumen 60/70	61600 t	6160000
Raw oil or acidic sludge	5400 t	Acidic sludge is free
Energy required for heating and melting of bitumen	3240 Giga Joul	It is compensated of by-products
Boxes 35 kg	34300 Number	34300
Barrels	60000 Number	480000
Blown bitumen 90/15	48000 t	12150000
Required electrical energy	642982.3 (KWH)	8037.83
Requird water (12 m^3 / day)	3600 m^3	248.2
Water supply facilities		15625
Split AC (Internal wiring, transformers and emergency power generators)		13125
Fire extinguishers (Total)	24 Number	1512
Stoves (Total)	4 Number	170
Cooler (Total)	2 Number	1000
Ventilation system (Total)	7 Number	140
Office equipments, furniture and etc	-	2500
Lab equipments (for quality control)	-	5000
Transportation (A vehicle weighing 4 tons, car and fork)	3 Number	40000
Staff salary	19 Persons	63333.33
Required fuel (Stoves)	1080 L	162
Petroleum expenses (Transportation vehicle and cars)	16200 L	3544
Required land	2800 m^2	35000
Construction of infrastructure (Buildings)	805 m^2	80500
Pavement and asphalt	1400 m^2	13562.4
Landscaping	1000 m^2	1000

[a] With 5% cost of installation

Table 6: Fixed and working capital

Fixed capital			
Description			Costs $
Required land, landscaping, buildings, pavement and asphalt			130062.4
Investment in facilities			39072
Investment in equipments and the installations costs			100290
Investment in transportation cars (A vehicle weighing 4 tons, car and fork)			40000
Unforeseen costs	3% investment (Fixed and working capitals)		44885.3
Costs before of the operation			10011
Total cost			364320.7
Working capital			
Description	Time		Cost $
Additives, packages and required materials*	45 days		1112383.3
Energy consumption (Water, fuel, petroleum and electrical costs) *	65 days		2886.97
Staff salary *	68 days		11799.08
Other costs	-	5% costs (∑*)	56353.5
Cost of sales	20 days		3328.76
Total cost			1186751.6

Table 9 represents that total manufacturing price is equal with 19335069. The required selling price is the price of the products which is required to encompass all costs (variable, fixed and overhead), recover the total investments and provide the specified return of the applied capital. In the end of the estimation, Table 10 presents the economic indices.

The values of value- added, value- added percent, profit, annual income, breakeven point, time of return on investment and investment rate are mainly economic indices. The time of return on investment is the least time that will pursue high profit as well as environment protection, business and sustainable development aspects. Analysis of breakeven point identifies the relationship between costs and revenue. The breakeven point is shown fixed and variable costs of the project in contrast with the running revenue.

The breakeven point prosecutes the lowest level of production which at this level profitability advents and at this level income of industry ample surrounds the fixed and variable costs. In an industry is vital the figuring the breakeven budget out to identify an expected market price for products at some points in the future or to evaluate the choice of retained ownership or sale of their products.

Table 7: Depreciation costs, maintenance, operational and non-operational fixed annual capital

Description	**Rate%**	**Capital value $**	**Costs of maintenance $**
Landscaping, buildings, pavement and asphalt	2	95062.4	1901.25
Facilities and equipments	10	39072	3997.2
Equipments without installations costs	5	95275.5	4763.77
Office equipments, furniture, etc	10	2500	250
Transportation cars (A vehicle weighing 4 tons, car and fork)	10	40000	4000
Unforeseen cost	5	39499	1974.95
Total cost			16887.2
Depreciation costs of fixed capital			
Description	**Depreciation rate**	**Capital value $**	**Cost of depreciation$**
Equipments without installations costs	10	95275.5	9527.55
Landscaping, buildings, pavement and asphalt	5	95062.4	4753.12
Office equipments, furniture and etc	20	2500	500
Transportation cars (A vehicle weighing 4 tons, car and fork)	10	40000	4000
Facilities and equipments	10	39072	3907.2
Costs before of the operation	20	10011	2002.2
Unforeseen cost	10	45783	4578.3
Total cost			29268.4

Table 8: Total fixed and variable manufacturing costs

Description	**%Fixed cost**	**Cost $**	**%Variable cost**	**Cost $**
Additives, packages and required materials	-	-	100	6674300
Maintenance of fixed annual capital	10	1688.72	90	15198.5
Energy consumption (Water, fuel, petroleum and electrical costs)	20	2398.4	80	9593.62
Unforeseen cost of fixed capital	-	44885.3	-	-
Staff salary	85	53833.33	15	9499.99
Depreciation of fixed capital	100	29268.4	-	-
Interest and fees	100	-	-	-
Insurance (0.2% of total investment)	100	728.6	-	-
Unforeseen costs of working capital	-	-	-	56353.5
Total cost		132802.75		6764945.6

Table 9: Total manufacturing price

Description	**Cost $**
Additives, packages and required materials	6674300
Staff salary	63333.33
Energy consumption	11992.03
Maintenance cost	16887.2
Depreciation of fixed capital	29268.4
Cost of insurance	728.6
Cost of interest and fees	-
Unforeseen costs*	135930.2
Total cost	6932439.76

*(2% total manufacturing costs)

Using of this practice in the present study represents the time of return on investment clearly.

Based on the studies of technical and economical view-point by Jonidi *et al.* the indices values such as value-added percent, profit, annual income, breakeven point, value-added, output value, data value, variable cost of commodity unit and production costs were found about 56.34%, $2795396.8, $2775522.94, $260.83, $2955795.3, $2289986, $5245781.3, $535 and $2470258.36 for the used-motor oil reprocessing industry equipped to acidic sludge recycling unit respectively.

The breakeven point about 6% and the time of return on investment of about 0.26 (3.2 months) represented the economic success of the project [47].

Table 10: Economic indices

Economic indices	**Cost $**
Data value	
Blown bitumen 90/15 (new product 110/15)	12150000
Output value	
Additives, packages and required materials	6674300
Maintenance	16887.2
Energy consumption	11992.03
Unforeseen costs of fixed capital	44885.3
Total cost	6748064.5
Value- added	5401935.47
Value- added percent	44%
Profit	5308605.14
Variable cost of commodity unit	140.93
Breakeven point (2.46%)	1183.67
Production cost	6897748.4
Annual income	5252251.65
Time of return on investment	0.07

In other research by Jonidi *et al.* the indices values such as value-added percent, profit, annual income and breakeven point value-added, output value were obtained to be about 68.2%, $ 249552.5, $ 248370.5, $ 131.4, $ 285134.75 and 132521.5 respectively. A low breakeven point is about 14.7% and the time of returns on investment 1.05 (about 13 months) also were indicative of the economic success of the project recycling acidic sludge to bitumen [48]. Iranian industry organization reported the breakeven point percent, time of return on investment and value-added percent around 22.5%, 0.9 (11 months), 36.3% respectively, for used-motor oil reprocessing industries without acidic sludge recycling unit. Jonidi *et al.* showed indices values such as value-added percent, profit, annual income, breakeven point, value-added, output value, data value, variable cost of commodity unit and production costs were found to be around 62%, $ 366558, $ 364292.6, $ 100.34, $ 423451.25, $ 255335.75, $ 678787, $ 389.65 and $ 314494.4 respectively. The breakeven point about 15.93%, the time of return on investment about 1.12 (13.7 months) were represented that this industry relatively needs long time to afford the employed capital and starts making profit [49].

Van Kasteren *et al.* have been studied on the sensitive key parameters such as the raw material price, plant capacity, glycerol price and capital cost in the conversion of waste cooking oil to biodiesel for three unit capacities (125,000; 80,000 and 8000 t/year) with the existing alkali, acid catalyst and a supercritical trans-esterification processes. The economic assessment showed that biodiesel can be sold at US$ 0.17/L (125,000 t / year), US$ 0.24/L (80,000 t / year) and US$ 0.52/L for the smallest capacity (8000 t / year) [50]. Zhang *et al.* showed that for three biodiesel plants with capacities 100,000 (1994), 7800 (1996) and 10,560 (1999) t / year the breakeven prices $ / ton 340,763, 420 were found respectively [51]. Nelson *et al.* (2006) showed that was produced between 527,000 and 1.27 million metric tons of Switchgrass per year in the Delaware basin in Kansas. The break-even price per Mg was calculated around $41 [52].

Cutler reported that decrease in the oil rates and energy return on investment has been raised to the energy costs of extraction of petroleum in the US. Energy return on investment surrounds the ratio of energy delivered to energy costs [53]. Greene *et al.* noticed that a feebate rate of $ 500 per 0.01 gallon per mile produce a 16 percent increases in fuel economy and 29% around $ 1000 so. Saving fuel for 3 years declines unit sales about 0.5 %. But sales will increase, because the added value of implementation fuel economy technologies outweighs the decrease in sales [54]. Gonzalez *et al.* showed cost of $ 0.49 L^{-1} of ethanol, cash cost of $ 0.46 L^{-1} and CAPEX of $ 1.03 L^{-1} of ethanol on the technical and financial performance of high yield Eucalyptus biomass. The main costs encompass the biomass, enzyme, tax, fuel, depreciation and labors. Profitability of the process is depends on biomass, carbohydrate percentage in biomass and enzyme costs [55]. Haas reported that generation cost of soap-stock biodiesel is US$ 0.41/L and about 25% less and biodiesel generated from soy oil [56]. Song *et al.*, represented that based on studies on the costs of raw materials and the potential market, the petroleum-based succinic acid process will be replaced by the fermentation succinic acid production system shortly [57].

3. The obtained results for the aggregates, base layer and asphalt operation

The performance of in-service pavements presents that the condition of the bonding between pavement layers plays an important role in the structures performance. Table 12 to 15 show the results of tests performed on the base layer and the hot mix asphalt. [58]. It was found in the temperature of hot mix asphalt 150^{oC} in the current study.

Table 11: Size of sieve, properties, ranges and specification of asphalt with heavy traffic [58]

Size of sieve (In)	Size of sieve (mm)	Cumulative passing (%)	Ranges	Specification of asphalt with heavy traffic	
1	25	-	-	Temperature	120-163 ^{o}C
3.4	19	100	100	Resistance	800 kg
1.2	12.5	97.70	90-100	Softness	2-3.5 mm
3.8	9.5	-	-	Breakage	90%
4	4.75	62.50	44-74	Empty space of asphalt (Topeka)	3-5%
8	2.36	37.90	28-58	Empty space of asphalt (Binder)	3-6%
50	0.3	10.50	5-21	Empty space of asphalt (Black base)	3-8%
100	0.15	6.80	-	Space filled with bitumen	65-75%
200	0.075	4	2-10	-	-

Table 12: Results of performed tests on base layer samples

Thickness (mm)	Compaction (%)	Moisture %	Density	Moisture at location %
100	98	6.7	2.27	3.4
120	99	6.7	2.27	2.3
110	98	6.7	2.27	3.3
100	97	6.7	2.27	2.8
80	97	6.7	2.27	3.9
120	97	6.7	2.27	3
120	98	6.7	2.27	2.9
95	97	6.7	2.27	3.6
160	100	5.7	2.29	2.8
130	98	5.7	2.29	3.3
140	99	5.7	2.29	3
120	98	5.7	2.28	2.8
110	97	5.7	2.28	2.7
120	97	6.7	2.27	3.7
100	99	6.7	2.27	3.1
120	98	6.7	2.27	3.2
110	99	6.7	2.27	2.5
110	97	6.7	2.27	3.4
120	98	6.7	2.27	3
100	97	6.7	2.27	2.7
110	98	6.7	2.27	2.2
115	98	6.7	2.27	3.2
130	97	6.7	2.27	3.3
90	99	6.7	2.27	2.3

Table 13: Results of performed tests on base layer samples

Specification of base layer with light and medium traffic	Values
Sand Equivalent	28%, 18%
LL	24%, 27%
PL	21%, 20%
PI	3%, 6%
D_{10}	0.5, 0.08
D_{30}	7, 4.9
D_{60}	21, 23

Table 14: Results of performed tests on hot asphalt and Marshall Samples

Specification of asphalt with light and medium traffic	Values
Thickness of asphalt (Medium)	6.2 cm, 6.1 cm, 7 cm, 7.3 cm
Empty space between aggregates	13.75%, 13.5%, 13%
Empty space aggregate filled of bitumen	70.75%, 71.2%, 72.3%
Aggregates rates	19266 g, 19260 g, 19261g
Bitumen / asphalt without bitumen	5.80, 5.80, 5.70
Empty space of mix asphalt	2.8%, 1.76 %, 2.9%
Sand Equivalent	27%, 29%, 30%

Table 15: Results of performed tests on hot asphalt and Marshall Samples

Bitumen/mix asphalt (%)	Resistance	Softness	Density	Breakage in two sides	Breakage in one side	Specific gravity	Bitumen%
5.2	950 kg	3.4 mm	2.27 g/cm^3	95 %	98 %	2.36 kg/cm^3	4.35%
5.17	1350 kg	3.95 mm	2.34 g/cm^3	95%	98%	2.2 kg/cm^3	4. 5%
5	990 kg	3.8 mm	2.29 g/cm^3	92%	97%	2.31 kg/cm^3	-
5.50	1159 kg	3.7 mm	2.3 g/cm^3	97 %	100 %	2.1 kg/cm^3	-
4.44	1560 kg	3.5 mm	2.31 g/cm^3	98%	100 %	2.3 kg/cm^3	-
5.60	1017 kg	3.8 mm	2.32 g/cm^3	85%	94%	2.3 kg/cm^3	-
5.20	950 kg	3.4 mm	2.27 g/cm^3	95 %	98 %	-	-
5.63	890 kg	2.17 mm	2.32 g/cm^3	94 %	-	-	-
5.32	899 kg	2.08 mm	2.15 g/cm^3	93%	-	-	-

CONCLUSION

These models were enabled to determine the strengths and weakness points to improve. The objective to use these models was present a realistic strategy for continuous improvement. The study of economic indices represents the confidence performance of the industries and job opportunities. The results of this research showed that these industries have an important role in the economic cycle of country due to convert the wastes to valuable products.

ETHICAL ISSUES

Ethical issues have been completely observed by the author

COMPETING INTERESTS

Author has no conflict of interests

AUTHORS' CONTRIBUTIONS

Author himself completed the design, conduct of the study, drafting, revising and approving of the manuscript.

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